PATENT SPECIFICATION

DRAWINGS ATTACHED

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COMPLETE SPECIFICATION

A.C. Transducer Device

We, SOCIETE D'ELECTRONIQUE ET D'AUTOMATISME, of 138 Boulevard de Verdun, Courbevoie, Seine, France, a French Body Corporate, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to an improved A.C. voltage transducer for use mainly in analogue computation, simulation and/or control systems of the kind wherein one at least of the analogue quantities involved is represented by a mechanical variable factor such as the movement of a mechanical part e.g. the angular displacement of an axle or the linear displacement of a tab or rule. In order to use such a mechanical quantity in such a system, it is often necessary to convert it into a corresponding electrical voltage. Furthermore it may be advantageous to apply a certain transfer coefficient or factor, which is a predetermined function of the variation in magnitude of the mechanical quantity during the said conversion step.

According to the present invention there is provided an A.C. transducer device having a transfer factor from the input to the output terminals thereof which is controlled from at least one mechanical control signal, comprising in combination three windings two of which are identical and identically arranged with respect to the third for defining therebetween a pair of identical air-gaps, said windings being mounted around separate magnetic cores, an A.C. supply for the said two windings in a circuit ensuring that the electromagnetic actions of the said windings on the third winding are opposed to each other and an output electrical circuit for the said third winding, and at least one diamagnetic screen so mounted as to be driven by a mechanical input signal and coooperating with one of the said air-gaps for controlling the coupling of one of the said two windings with the third in a relation with the value at any time of the said mechanical input signal. The windings may be mounted around separate magnetic cores, and electrostatic shields inserted in each of the air-gaps.

One preferred embodiment of the present invention will now be described with reference to the accompanying drawings, in which;

Fig. 1 shows a circuit diagram of an A.C. transducer device according to the invention.

Figs. 2 and 3 are diagrammatic views in elevation and plan respectively of one illustrative embodiment according to the present invention.

With reference to the drawings, a diagrammatic screen 1 made for example from thin copper sheet is driven from an axle or shaft 2. At any time the angular position of this shaft 2 with respect to a fixed reference position will be a measure of the magnitude of the mechanical control input signal to the transducer. When required a conventional gear effecting the conversion of a translation into a rotation will be used for the drive of the said shaft 2.

The said diamagnetic screen is flat and its profile defines *per se,* with respect to the profile of the air-gap 3 within which the said screen is adapted to move, a definite transfer law for the control of the transfer factor from the electrical input to the electrical output of the said transducer. In Fig. 3, the shape of the screen 1 may be considered as arbitrary though very near to that ensuring a linear transfer law with respect to the circular shape of the cooperating air-gap. It must be understood that, when the input control signal is zero, the condition of the screen with respect to the air-gap may for instance be that where the edge of the screen 1 registers with the edge of the air-gap, the screen being then totally external to the air-gap.

The required transfer law may not be specifically obtained from the shape or profile of the diamagnetic screen with respect to that of the air-gap. It may also be determined, at least partly from a mechanical coupling be-

tween the input shaft of the mechanical control signal and the shaft driving the diamagnetic screen. Such a predetermined transfer law imposing mechanism is well known *per se* for other purposes than those intended in the present invention and, may comprise a suitably profiled cam on one of the cooperating shafts and a follower arrangement controlling the rotation of the other one or vice-versa.

From an electrical point of view, a device according to the invention comprises three electrical windings arranged in relative registration, as shown in Figs. 1 and 2. The windings 7 and 8 are identical and are identically set on either side of the winding 5. The windings 7 and 8 act as "primary" windings and are serially connected to one pair of terminals 11 to which is applied an A.C. voltage, of any alternating waveform not necessarily a sinusoidal waveform and which may be amplitude, phase or frequency modulated if desired. The winding 5 acts as a "secondary" winding and, without any screen of a diamagnetic nature in any air-gap, the magnetic flux induced in said winding from the windings 7 and 8 balance each other out (at least in theory) so that the output signal at the output terminals 4 of the winding 5 is zero. Each winding as shown cooperates with a magnetic core, 6 for the winding 5, 9 and 10 for the windings 7 and 8. Each part of the thus constituted structure is of a cylindrical shape, the cores registering in the axis thereof. Two identical air-gaps 3 and 3^1 are thus defined in the said structure.

A pair of electrostatic shields 12 and 13 are shown within the said air-gaps cooperating respectively with the parts 7—9 and 8—10 of the structure. These shields reduce the stray inter-part capacities between the "primary" and the "secondary" windings so that the actual output will tend to be zero in the balanced condition as mentioned above. When such electrostatic shields are not provided, the output may not be nil but constitute a minimum output above which must then be adjusted the operative threshold of any load circuit which may be connected to and supplied from the output terminals 4 of the device. However, as is apparent to an engineer, the requirement of a threshold may not be *per se* a definite drawback so that, in some cases, the electrostatic shields may be dispensed with.

The operation of the device will now be described. According to the angular position of the control shaft 2, the diamagnetic screen 1 occupies a certain position within the air-gap 3 and consequently the mutual inductance between 8 and 5 depends on this position and is not as high as the mutual inductance between 7 and 5. The output signal at 4 will be equal to the input signal at 11 as transferred from 7 to 5 minus that part of the said input signal at 11 transferred from 8 to 5 the value of which depends on the position of the diamagnetic screen 1 within the air-gap. As the mechanical control signal varies, the law of transfer from 11 to 4 varies accordingly. Of course, this variation may be made linear if required, but it may be made in accordance with any mathematical or arbitrary law as desired. When the input signal at 11 is modulated according to any well known kind of modulation, this modulation will not be affected by the transfer law, and will not affect this law.

Such an arrangement may obviously be used as a so-called function transducer or an analogue multiplier of an electrical signal at 11 and a mechanical signal at 2. Other uses will be apparent to the analogue computer specialist.

However a modified form of device according to the invention enables it to be used in a servo-system. As shown in dotted lines on Fig. 2, a second diamagnetic screen 1^1 may be driven from a shaft 2^1 and cooperates with the other air-gap 3^1 of the device. It is obvious that the output signal will now depend on both the conditions of the diamagnetic screens, and consequently on both the mechanical signals controlling the said conditions. Actually, the output signal at 4 will follow a law which is, at any time, proportionally related to the difference between the instantaneous values of the two mechanical controls as seen through their respective transfer laws defined, for instance, by the shape or profile of their respective diamagnetic screens. When the shaft 2 is that driving a servo-mechanism and the shaft 2^1 is one of the slave shafts of the said servo-mechanism, both screens 1 and 1^1 being of similar or identical shape according to whether the said shafts are or not of identical drive speed range, then the output voltage collected at the output terminals 4 will represent the position error signal of the servo-mechanism.

WHAT WE CLAIM IS:—

1. An A.C. transducer device having a transfer factor from the input to the output terminals thereof which is controlled from at least one mechanical control signal, comprising in combination three windings two of which are identical and identically arranged with respect to the third for defining therebetween a pair of identical air-gaps, said windings being mounted around separate magnetic cores, an a.c. supply for the said two windings in a circuit ensuring that the electromagnetic actions of the said windings on the third windings are opposed to each other and an output electrical circuit for the said third winding, and at least one diamagnetic screen so mounted as to be driven by a mechanical input signal and cooperating with one of the said air-gaps for controlling the coupling of one of the said two windings with the third in a relation with the value at any time of the said mechanical input signal.

2. An A.C. transducer device according to claim 1 wherein electrostatic shields are inser-

ted in each one of the said air gaps.

3. An A.C. transducer device according to claim 1 or claim 2 wherein the said diamagnetic screen is driven by the said mechanical input signal through a transfer-law imposing mechanism between the member applying the said mechanical input signal to the device and the member therein driving the said diamagnetic screen.

4. An A.C. transducer device according to any one of the preceding claims wherein a pair of diamagnetic screens, each of which is separately controlled by a distinctive mechanical input, signal, respectively cooperate with the pair of the said airgaps in the device.

5. An A.C. transducer device constructed and arranged substantially as herein described with reference to and as shown in the accompanying drawings.

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851543 COMPLETE SPECIFICATION
1 SHEET *This drawing is a reproduction of the Original on a reduced scale*

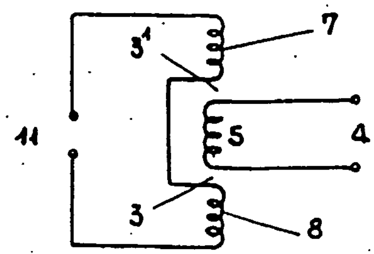

FIG.1

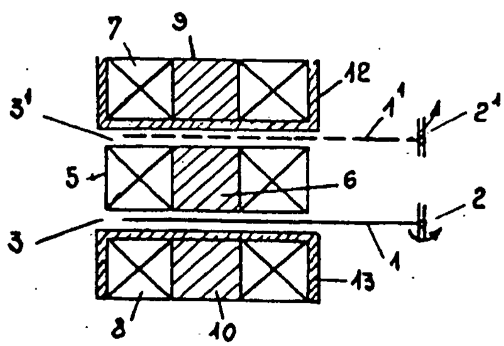

FIG.2

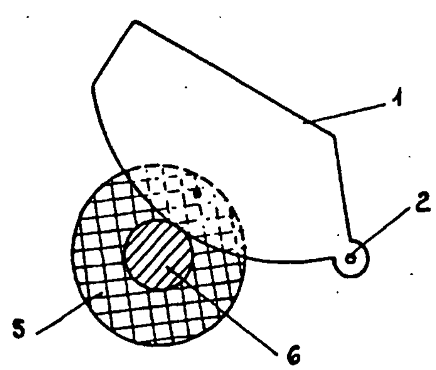

FIG.3